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THE BEHAVIOR OF TELIA OF PUCCINIA GRAMINIS IN THE SOUTH

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Since July, 1918, the writer has had under observation the behavior of telia of *Puccinia graminis* Pers. on various grasses and the relationship of this spore stage to the overwintering and dissemination of the rust. It is well known that barberries, both native and introduced, are present in the southern states, and yet infections on this alternate host are apparently rare. Stakman (Separate from Yearbook of the United States Dept. of Agric. No. 796, 1918, p. 25) says, "There can be no question whatever that the barberry is the most important factor in the spread of rust in the northern half of the Mississippi basin. In the South it is less important." In a previous paper Rosen and Kirby (Phytopathology **9**: 569–573. 1919, p. 571) record the absence in the Arthur Herbarium of aecial collections of *P. graminis* from the southern states. It was with the thought that a study of the behavior of telia might shed some light on the lack of barberry infections that these observations were undertaken at Fayetteville, Arkansas, latitude 36°. While the average temperatures prevailing at Fayetteville are lower than those in a major part of the state, the observations made in other sections indicate a close similarity in the behavior of stem rust.

As a rule black stem rust is not nearly as widespread or as destructive as the various leaf rusts. Occasionally, as in 1919, the wheat leaf rust, *Puccinia triticinia* Erikss., is so destructive that fields are abandoned and left unharvested, while the stem rust is only rarely observed. However, the stem rust of red top, *Agrostis palustris* Huds. (*A. alba* of authors) of timothy, *Phleum pratense* L., and of *Elymus australis* Scrib. and Ball is often prevalent. Perhaps it will be worth while to point out that the main difference between the urediniospores of the stem and leaf rusts is in the arrangement of the pores, being always equatorially disposed in the stem rust and always scattered in the leaf rusts. Such characters as color, shape, and size of the spores vary with hosts, with degree of maturity and somewhat with environmental conditions. Racial differences are well known. The uredinia of stem rust have been studied, and dates kept of the earliest and latest appearance, but a discussion of this stage will be left for the future.

As compared to the uredinia, the telia of stem rust of the cereals are rare and underdeveloped in this state. At harvesting time, or indeed at any other time, while the uredinia may be readily found it usually takes careful searching to obtain telia. Moreover, examination of telia under the microscope shows spores which are considerably undersized and otherwise abnormal. In the fall of 1918, as well as in the fall of 1919, wheat straw containing telia, collected around Fayetteville, were put into wire cages and allowed to remain out of doors during the winter. No germination occurred, in contrast to the teliospores of over-wintered material of *Elymus australis* which germinated profusely as will be described. No explanation is at hand for this lack of normal telial development. It seems probable that the frequent and prolonged "dry spells" characteristic of the growing seasons of this section may have some influence on the development of telia. Possibly the time of wheat harvesting, usually in the first half of June, coming considerably earlier than in the sections where a profuse development of normal telia is common, as in the spring wheat section, may have something to do with it.

But while the cereal grasses ordinarily do not produce viable telial material the writer has carefully checked up the viability and infectivity of this stage on *Elymus australis*,[1] one of the common grasses of the region around Fayetteville. It is rather drought resistant, frequently to be seen making good growth when other grasses, both wild and cultivated, are either dead or suffering for want of moisture. During the fall of 1919 a very heavy infestation of the stem rust, in the form of telia, was noted in a good-sized patch of *Elymus* growing along a road side. The telia, unlike those observed on the cultivated cereals, appeared well developed, of a blackish color, and when examined under

[1] The writer is indebted to Mrs. Agnes Chase of the U. S. Department of Agriculture for the identification of this grass.

the microscope showed spores of a typically normal type in size, shape and color. The unique character of this telial material contrasting strongly with lack of telial development on other hosts and especially with material collected on the same day on timothy in which no telia but a very heavy infestation of uredinia was observed, made it appear worth while to study this *Elymus* infection. Several times during the fall, winter and early spring attempts were made to germinate the material collected on these different occasions but always without success. Profuse germination was finally obtained from material collected on April 5. This germinating material was smeared on young, moistened leaves of *Berberis trifoliolata* Moric., on a potted plant growing in the greenhouse, and the whole plant covered with a bell-jar for forty-eight hours. Another plant, uninoculated, served as a check. Reddish-yellow, cushion-like spots began to develop in about six days, and in eleven days, numerous pycnia, mostly epiphyllous, had developed. No infections developed on the check plant. The pycnia were typical of *Puccinia graminis* and the infections as a whole were similar to those obtained on the same host infected by using germinating telia on wheat straw coming from Iowa. (See Rosen and Kirby, loc. cit., p. 571.) It should be added that the telia were viable on April 29 and that on June 25 no germination was obtained. No data is at hand to indicate to which specialized race the telia of *Elymus australis* belong. Apparently this species of *Elymus* has not previously been recorded as a host for *P. graminis* and material has accordingly been deposited in the Arthur Herbarium. However, Stakman and Piemeisel (Jour. Agr. Res. **10**: 429–495. 1917) list various species of *Elymus* as congenial hosts for two specialized races which attack wheat, the "biologic forms" *tritici* and *tritici compacti,* for the one which attacks rye, *secale,* and for the oat race, *avenae,* which appears only slightly infectious on *Elymus* spp.

The telia on *E. australis* here recorded are of interest not only because they differ from the ordinary behavior of stem rust telia in this region, but because they clearly show that if telia are fully developed they can be "overwintered" properly in this region and that they are infectious.

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